

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Douglas Little on January 6, 2010.

The application has been amended as follows:

Amendments to the Claims:

1. (Previously Presented) A method comprising:
 - bringing a fluid into contact with the surface of a surface acoustic wave sensor;
 - propagating input waves through the surface acoustic wave sensor to produce transmitted waves;
 - determining a phase frequency response of the transmitted waves;
 - identifying a segment of phase frequency response by determining first and second phase inflection frequencies, at +180 and -180 degree phase points, proximate to a running frequency associated with the surface acoustic wave sensor;
 - estimating a time delay associated with wave propagation through the surface acoustic wave sensor based on the identified segment of phase frequency response;
 - identifying a material in the fluid as a function of an estimated propagation velocity, the estimated propagation velocity being estimated based on the estimated time delay.

2. (Canceled)

3. (Previously Presented) The method of claim 1, wherein determining phase inflection frequencies comprises:

sampling a plurality of phase responses at frequencies proximate to the running frequency and initially estimating phase inflection frequencies as a function of the plurality of phase responses at frequencies proximate to the running frequency;

sampling a plurality of phase responses at frequencies proximate to the initially estimated phase inflection frequencies; and

more accurately estimating the phase inflection frequencies as a function of the plurality of phase responses at frequencies proximate to the initially estimated phase inflection frequencies.

4. (Previously Presented) The method of claim 1, wherein the first and second phase inflection frequencies define edges of a monotonically changing subset of a graph of phase versus frequency of the surface acoustic wave sensor.

5. (Currently amended) The method of claim 1 further comprising:

~~identifying the segment of phase frequency response of the surface acoustic wave sensor by determining first and second phase inflection frequencies proximate to the running frequency associated with the surface acoustic wave sensor; and~~

estimating the time delay associated with wave propagation through the surface acoustic wave sensor based on the identified segment of phase frequency response according to approximately the following equation:

$$\hat{\tau}(f_0) = \frac{f_1}{f_0} \frac{1}{f_2 - f_1} - \frac{1}{360} \frac{\phi(f_0)}{f_0} + \frac{0.5}{f_0} \text{ where } \hat{\tau}(f_0) \text{ is the time delay at frequency}$$

f_0 , f_0 is the running frequency, f_1 is the first phase inflection frequency, f_2 is the second phase inflection frequency, and $\phi(f_0)$ is a measured phase response of the surface acoustic wave sensor at frequency f_0 .

6. (Previously presented) The method of claim 1, further comprising estimating the time delay according to approximately the following equation:

$$\hat{\tau}(f_0) = -\frac{1}{360} \frac{f_*}{f_0} \dot{\phi}(f_*) - \frac{1}{360} \frac{1}{f_0} \phi(f_0) + \frac{1}{360} \frac{1}{f_0} \phi(f_*)$$

where $\hat{\tau}(f_0)$ is the time delay, f_0 is the running frequency, $\phi(f_0)$ is a measured phase response of the surface acoustic wave sensor, f_* is any frequency between a first phase inflection frequency and a second phase inflection frequency, $\phi(f_*)$ is a measured phase frequency response at the frequency f_* , and $\dot{\phi}(f_*)$ is a first order of derivative of the measured phase response at the frequency f_* .

7. (Previously presented) The method of claim 1, further comprising estimating the time delay according to approximately the following equation:

$$\hat{\tau}(f_0) = -\frac{1}{360} \dot{\phi}(f_0)$$

where $\hat{\tau}(f_0)$ is the time delay, and $\dot{\phi}(f_0)$ is a first order of derivative of a measured phase response at a frequency f_0 .

8. (Previously presented) The method of claim 1, further comprising estimating the time delay according to approximately the following equation:

$$\hat{\tau}(f_0) = \frac{1}{f_0} \frac{f_1}{f_2 - f_1} - \frac{1}{360} \frac{1}{f_0} \phi(f_0) + \frac{0.5}{f_0} + \frac{1}{180} \frac{1}{f_0} \frac{1}{f_2 - f_1} \int_{f_1}^{f_2} \phi(f_{00}) df_{00}$$

where $\hat{\tau}(f_0)$ is the time delay, f_0 is the running frequency, f_1 is the first phase inflection frequency, f_2 is the second phase inflection frequency, and $\phi(f_0)$ is a measured phase response of the surface acoustic wave sensor, integral

$\int_{f_1}^{f_2} \phi(f_{00}) df_{00}$ is equal to integral $\int_{f_1}^{f_2} \phi(f) df$, where $\phi(f)$ is a measured phase

response at frequency f and f varies from f_1 to f_2 .

9. (Currently amended) The method of claim 1, further comprising estimating the propagation velocity of a surface acoustic wave through the surface acoustic wave sensor from the estimated time delay according to the following equation:

$$\hat{v}(f) = \frac{L}{\hat{\tau}(f)}, \text{ where } \hat{v}(f) \text{ is the estimated propagation velocity of the surface}$$

acoustic wave at frequency f , $\hat{\tau}(f)$ is the estimated time delay at the frequency f , and L is a distance between centers of an input inter-digitized transducer (IDT) and an output IDT which are part of the surface acoustic wave sensor.

10. (Canceled)

11. (Original) The method of claim 1, wherein the surface acoustic wave sensor comprises a Love mode shear-horizontal surface acoustic wave sensor.

12. (Currently amended) A computer-readable medium comprising instructions that when executed in a processor:

determine phase frequency response of transmitted waves of a surface acoustic wave sensor;

identify a segment of phase frequency response of a the surface acoustic wave sensor by determining first and second phase inflection frequencies proximate to a running frequency associated with the surface acoustic wave sensor; ~~and~~

estimate a time delay associated with wave propagation through the surface acoustic wave sensor based on the identified frequency response according to approximately the following equation:

$$\hat{\tau}(f_0) = \frac{f_1}{f_0} \frac{1}{f_2 - f_1} - \frac{1}{360} \frac{\phi(f_0)}{f_0} + \frac{0.5}{f_0}$$

where $\hat{\tau}(f_0)$ is the time delay at frequency f_0 , f_0 is the running frequency, f_1 is the first phase inflection frequency, f_2 is the second phase inflection frequency, and $\phi(f_0)$ is a measured phase response of the surface acoustic wave sensor at the running frequency f_0 ; and

identify a concentration of a material in a fluid as a function of an estimated propagation velocity that is based on the estimated time delay.

13. (Canceled)

14. (Previously Presented) The computer-readable medium of claim 12, further comprising instructions that when executed determine phase inflection frequencies for a discrete phase frequency response by:

sampling a plurality of phase responses at frequencies proximate to the running frequency and initially estimating phase inflection frequencies as a function of the plurality of phase responses at frequencies proximate to the running frequency; sampling a plurality of phase responses at frequencies proximate to the initially estimated phase inflection frequencies; and

more accurately estimating phase inflection frequencies as a function of the plurality of phase responses at frequencies proximate to the initially estimated phase inflection frequencies.

15. (Previously Presented) The computer-readable medium of claim 12, wherein the first and second phase inflection frequencies define edges of a monotonically changing subset of a graph of phase versus frequency of the surface acoustic wave sensor.

16.-19. (Canceled)

20. (Currently amended) The computer-readable medium of claim 12, further comprising instructions that when executed estimate a propagation velocity of the surface acoustic wave from the estimated time delay according to the following equation:

$\hat{v}(f) = \frac{L}{\hat{\tau}(f)}$, where $\hat{v}(f)$ is the estimated propagation velocity of the surface

acoustic wave at frequency f , $\hat{\tau}(f)$ is the estimated time delay at frequency f , and L is a distance between centers of an input inter-digitized transducer IDT and an output IDT which are part of the surface acoustic wave sensor.

21. (Canceled)

22. (Original) The computer-readable medium of claim 12, wherein the surface acoustic wave sensor comprises a Love mode shear-horizontal surface acoustic wave sensor.

23. (Currently amended) A system comprising:

a surface acoustic wave sensor;

a sensor analyzer to receive output of the surface acoustic wave sensor and determine a phase frequency response from the output; and

a processor to receive input from the sensor analyzer, identify a segment of phase frequency response of the surface acoustic wave sensor by determining first and second phase inflection frequencies proximate to a running frequency associated with the surface acoustic wave sensor, estimate a time delay associated with wave propagation through the surface acoustic wave sensor based on the identified segment of phase frequency response according to approximately the following equation:

$$\hat{\tau}(f_0) = \frac{f_1}{f_0} \frac{1}{f_2 - f_1} - \frac{1}{360} \frac{\phi(f_0)}{f_0} + \frac{0.5}{f_0} \text{ where } \hat{\tau}(f_0) \text{ is the time delay at frequency } f_0, f_0$$

is the running frequency, f_1 is the first phase inflection frequency, f_2 is the second phase inflection frequency, and $\phi(f_0)$ is a measured phase response of the surface acoustic wave sensor at the running frequency f_0 , and estimate a propagation velocity of the surface acoustic wave based on the estimated time delay, and identify a concentration of a material in a fluid as a function of the estimated propagation velocity.

24. (Canceled)

25. (Previously Presented) The system of claim 23 wherein the processor determines the phase inflection frequencies by:
sampling a plurality of phase responses at frequencies proximate to the running frequency and initially estimating the phase inflection frequencies as a function of the plurality of phase responses at frequencies proximate to the running frequency;
sampling a plurality of phase responses at frequencies proximate to the initially estimated phase inflection frequencies; and
more accurately estimating the phase inflection frequencies as a function of the plurality of phase responses at frequencies proximate to the initially estimated phase inflection frequencies.

26. (Previously presented) The system of claim 23 wherein the first and second phase inflection frequencies define edges of a monotonically changing subset of a graph of phase versus frequency of the surface acoustic wave sensor.

27.-30. (Canceled)

31. (Currently amended) The system of claim 23, wherein the processor estimates a propagation velocity of the surface acoustic wave based on the estimated time delay according to the following equation:

$\hat{v}(f) = \frac{L}{\hat{\tau}(f)}$, where $\hat{v}(f)$ is an estimated propagation velocity of the surface acoustic wave at a frequency f , $\hat{\tau}(f)$ is the estimated time delay at the frequency f , and L is a distance between centers of an input inter-digitized

transducer IDT and an output IDT which are part of the surface acoustic wave sensor.

32.-33. (Canceled)

34. (Original) The system of claim 23, wherein the surface acoustic wave sensor comprises a Love mode shear-horizontal surface acoustic wave sensor.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nashmiya S. Fayyaz whose telephone number is 571-272-2192. The examiner can normally be reached on Tuesdays and Thursdays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hezron E. Williams can be reached on 571-272-2208. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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